Observations on *Pervicacia tristis* (Deshayes, 1859) and a Comparison with other Toxoglossan Gastropods

BY

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(5 Text figures)

INTRODUCTION

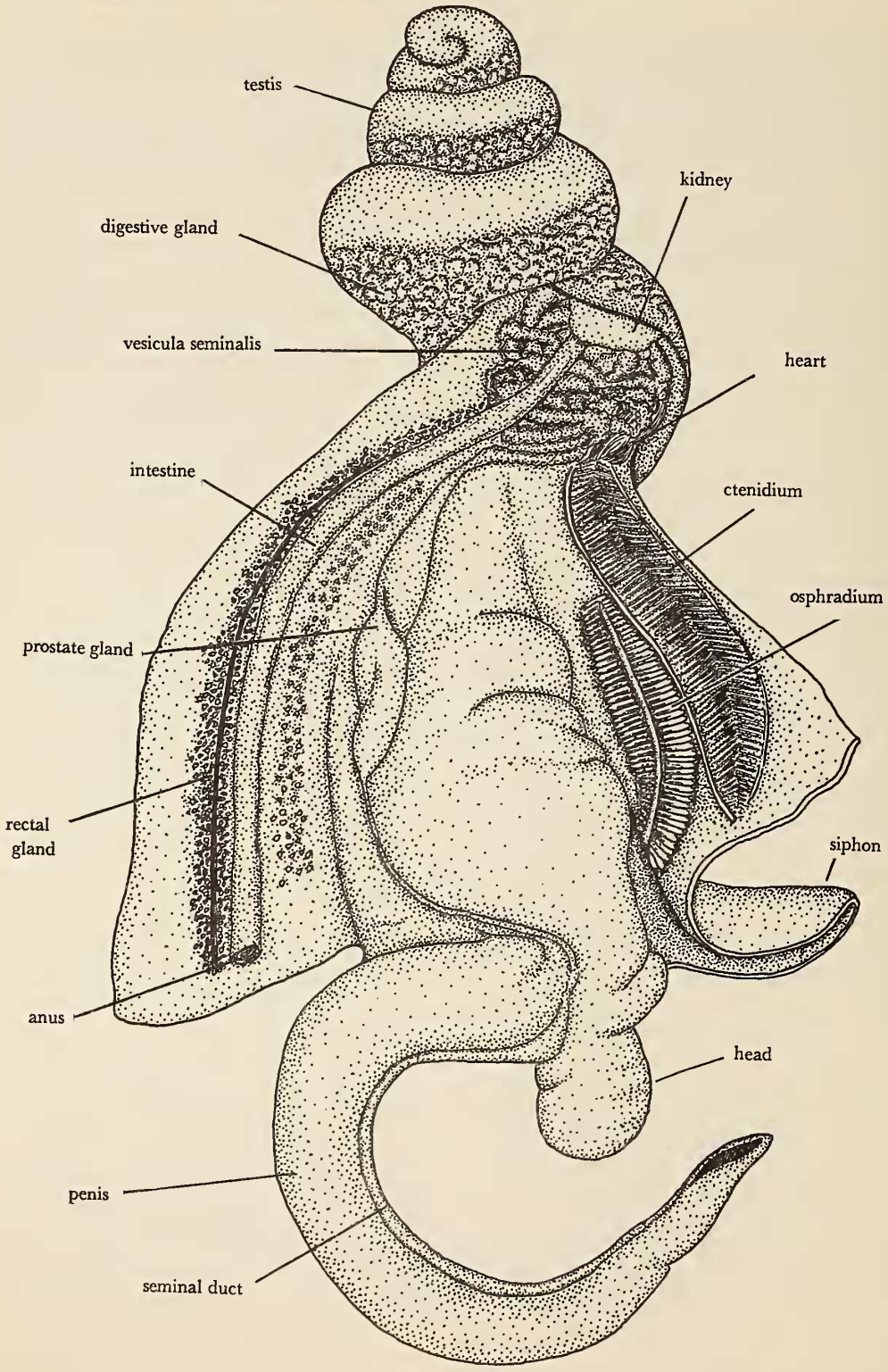
The toxoglossan prosobranch molluscs are a group of specialised carnivores typified by a powerful neurotoxic secretion and harpoon-shaped radular teeth. The most studied family is the Conidae with work by Kohn, Cernohorsky and others. The cones studied so far are all active selective predators, catching molluscs, worms and fish (Kohn, 1959, 1956, 1955 - 1956). This family is not present in New Zealand, but the toxoglossans are represented by the Turrids, which are generally uncommon and of small size, and the terebrid-like genus *Pervicacia* which is also reported from Southern Australia and Japan. The animal investigated is *Pervicacia tristis* (Deshayes, 1859), a member of the infauna of silty sand banks at low water. Specimens were collected on the east coast, north of Auckland at the Whangateau Harbour and at the mouth of the Wade River. This animal lives just below the surface of the sand, and often is found under small mounds. *Pervicacia* lives in association with two tube worms, *Owenia fusiformis* Chiaje, 1844 and *Axiothella quadrimaculata* Augener, 1914, and the molluscs *Marginella pygmaea* Sowerby, 1846, *Paratrophon stangeri* (Gray, 1843), *Zeacumantus* spp., and *Baryspira* spp. Accompanying these species is a small cumacean crustacean, probably of the genus *Diastylis*, which *Pervicacia* could possibly feed on. The animals collected refused to eat in captivity and the gut contents were unrecognisable.

The animals were usually examined alive and dissected under a binocular microscope. For histological and anatomical investigation animals were fixed in Bouin's fixative and the sections cut were stained with either Weigert, van Giesen or Mallory Heidenhain stains.

EXTERNALS — SHELL and BODY

Pervicacia tristis has a slender auger-shaped shell attaining 20 mm in height and 6 mm in width. Few animals, however, reach this size. The coiling is dextral and radial ribbing is often present, sometimes being very pronounced. There is a horny operculum which fills the aperture when the animal retracts. The body is translucent, with many small white blotches showing under the surface formed by a granular secretory substance found throughout the foot and mantle regions.

The mantle cavity is wide and extremely deep, water being drawn into it through the long inhalant siphon and tested by the large osphradium before running over the gills and passing out through an exhalant groove. The large brown bipectinate osphradium lies on the extreme left of the mantle cavity. To the right of this organ is the long monopectinate ctenidium, each lamina being triangular with one side being fixed to the mantle, extending to the back of the mantle cavity. The genital duct opens also on the right, near the mantle edge in the female, and into the penis in the male. To the left of this organ is the rectum opening by a small anus. Between the long black rectal gland and the ctenidium is the large hypobranchial gland which produces a reddish purple secretion. There are neither eyes nor tentacles. The sexes are separate, the female duct ending in a large muscular ring and the male duct in a long flat penis. The lack of


testis
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digestive gland
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prostate gland
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penis
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eyes and tentacles, the large osphradium and the increase in activity at night suggest that *Pervicacia* is nocturnal, locating food by chemosensory means (Figure 1).

ALIMENTARY CANAL

On the ventral surface of the "head" or "snout" is an opening, bordered longitudinally by a pair of muscular lips, which forms the apparent mouth. This opening leads into an anterior cavity which encloses the distal region of the proboscis bearing the true or inner mouth. The "snout" region, as is discussed later, is probably homologous with the pseudoproboscis of the terebrids (Figures 1, 4 P). The walls of the anterior cavity have a simple glandular epithelium overlain by a thin layer of transverse (or radial) muscle fibre. This is surrounded by a layer of muscle and connective tissue. In *Hastula cinerea* (Born, 1780) an "anterior tube" has been described, which when everted, corresponds to this region (Marcus & Marcus, 1960). In all specimens, whether alive or preserved, this region was always extended and appeared incapable of withdrawal. The buccal tube, or proboscis, which is only attached to the body wall by a few small muscles, is wide and highly muscular. Underlying the simple epithelium lining the lumen, is a thin layer of longitudinal muscles, followed by an ordered array of circular and transverse (or radial) muscle blocks. On the floor of the buccal tube is the odontophore, bearing a radula with two rows of simple triangular teeth (formula 1·0·0·0·1). The radular sac is short. Odontophoral cartilages are present, contradicting Fretter & Graham's (1962) statement that these have been lost in the Toxoglossa. The cartilaginous blocks are moved by two well-developed muscles, M_1 and M_2. When M_1 contracts and M_2 relaxes, the odontophore rocks forward and when M_1 is relaxed and M_2 contracts, the cartilage rocks backwards (Figure 4 S).

The apparently single salivary gland runs forward, splitting in two. The ducts from each lobe join, forming a common duct which enters the buccal tube near the mouth (Figure 4 P). The oesophagus recurves sharply twice, immediately behind the buccal tube, and then passes through the nerve ring. The lining at the anterior end of the oesophagus is ciliated and slightly folded, while further back the folding increases and the layer of longitudinal muscle is replaced by a larger one of circular muscle. It is difficult to demarcate the transition from oesophagus to stomach, but the stomach can be distinguished by heavier foldings of its wall. The gut wall here contains odd groups of globules staining bright red with Mallory Heidenhain and there is a thick layer of circular muscle. Two large ducts leave the digestive gland, merging to enter the stomach by a single opening. The histology of the digestive gland is similar to that of some stenoglossans described by Fretter & Graham (1962).

The intestine can be divided into two regions. Near the stomach, red staining areas of granular cells are abundant in the intestinal wall. The diameter of the lumen of the intestine increases, almost all the folding disappears, and the wall becomes very thin. This region of the intestine is heavily ciliated and is the widest region of the alimentary canal. The pallial or distal region of the intestine is quite different. Near the back of the mantle cavity, the intestine narrows and becomes triangular in cross-section, the wall having large areas of red-staining granules. It has no musculature and runs through the mantle as a narrow, thick-walled, folded tube. It opens near the edge of the mantle cavity and is followed down the mantle by the rectal or anal gland (Figures 1, 3 B).

REPRODUCTIVE SYSTEM

The ovary is a lobulated organ overlying the digestive gland in the top whorls of the body. The ova stain grey with Weigert, van Giesen stain. Part of the ovary is packed with bright yellow staining oocytes. The genital duct opens into the mantle cavity just behind the anus and is modified into several specialized regions: albumen gland; ingesting gland; capsule gland; and glandular vestibule. The ovarian duct, leading from the ovary to the albumen gland, is comparatively short, and is lined with a simple epithelium. From it is a duct to the pericardial cavity. The albumen gland has greatly folded walls, lined with secretory and ciliated cells. Below the albumen gland is the capsule gland (Figure 2 U). At the junction of the two, a duct leads off to the "ingesting gland." The capsule gland is a large secretory region in which the duct has become extended to form a narrow dorso-ventral slit running forward in the mantle to open anteriorly into a large distensible vestibule with folded muscular walls (Figure 3 B). This vestibule is a long muscular groove opening into the mantle cavity. The muscular opening of the groove could be considered the vagina. There is no bursa copulatrix.

The length of the penis and the fact that it opens at its tip suggests that this organ enters the capsule gland

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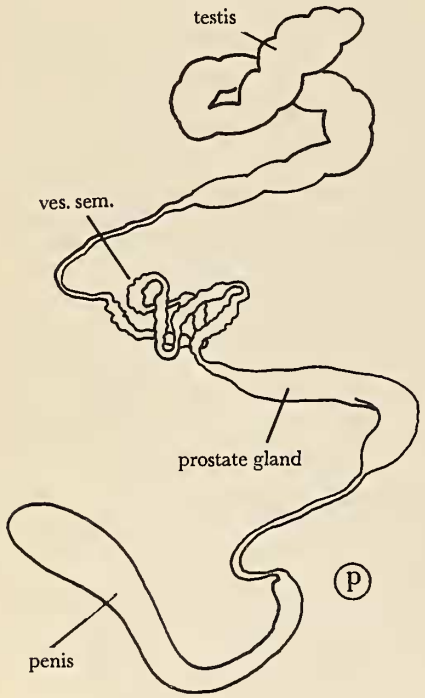
Figure 1

Pervicacia tristis (Deshayes, 1859)
Male, with mantle cavity opened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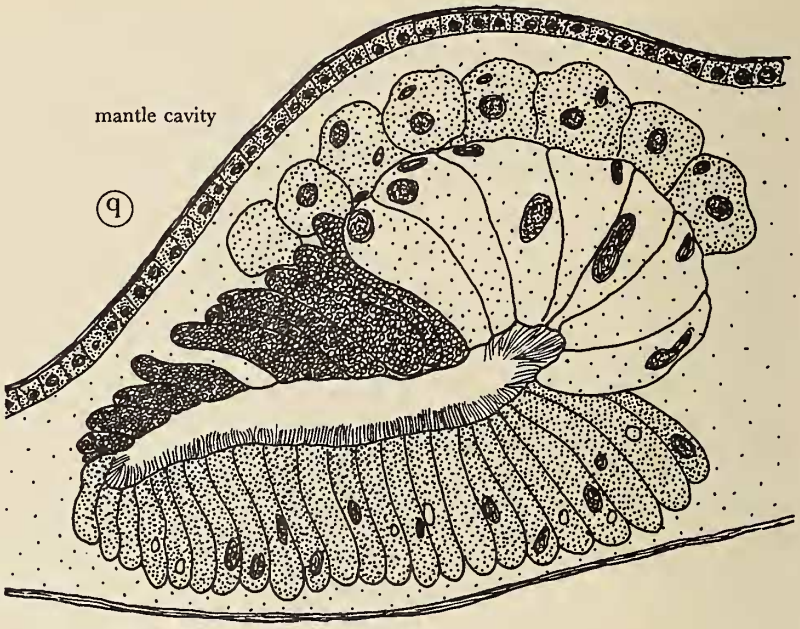
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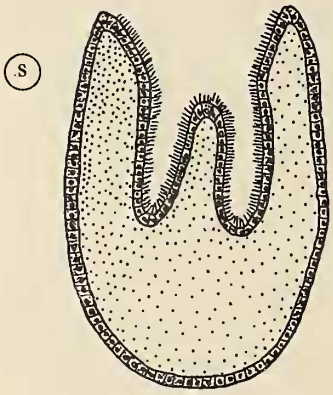
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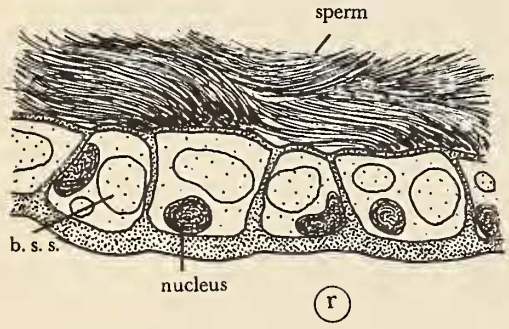
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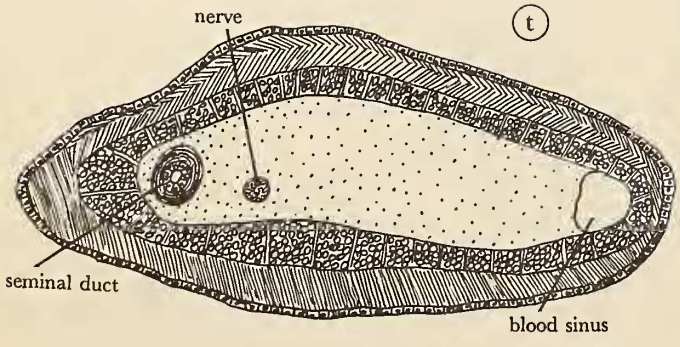
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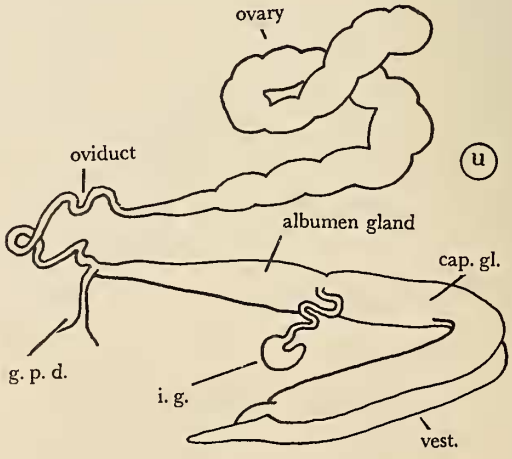
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during copulation. The duct to the "ingesting gland" has a glandular lining and is surrounded by a layer of circular muscle. The cells of the epithelium are undifferentiated and the duct often contains large numbers of oriented sperm. This duct to the "ingesting gland" has been considered by FRETTER to be homologous with the receptaculum seminalis of lower gastropods. It leads into a sausage-shaped gland which in the live animal has a brown outer covering. The gland is lined with vacuolated cells containing groups of spherules staining brown with Mallory, Heidenhain stain, vacuoles apparently being a site for the ingestion of sperm. Unoriented sperm is found loose in the lumen of the gland and also caught against the walls of the gland cells. There is a layer of connective tissue surrounding the gland cells. The duct and gland both have a fairly thick layer of circular muscle. This gland is no doubt the ingesting gland described by FRETTER (1941). The capsule gland is a secretory region where the genital duct has been extended into a narrow dorso-ventral slit. There are two distinct glandular regions: a dorsal region and a lateral one. At the ventral side of the lumen (Figure 3 B) there is a loop to the animal's left (i. e. a loop towards the centre of the mantle cavity) which at its anterior end opens into the vestibule. In FRETTER's account of the genital ducts of four prosobranchs (FRETTER, 1941) she describes left and right longitudinal folds. *Pervicacia* and *Hastula* (MARCUS, 1960) have only a left fold. The lateral glandular region is the most prominent area and consists of groups of cells at different heights packed together in lobes. The ducts of these secretory cells run parallel to one another to open into the lumen of the gland through the columnar ciliated epithelium. The dorsal lobe of glandular tissue appears to be mucus-secreting and has a much lighter appearance than the lateral lobe.The female duct ends in a terminal pouch, similar to that described by MARCUS & MARCUS (1960) in *Hastula cinerea*.

The reproductive system of the male can be divided into six regions: testis; testis duct; vesicula seminalis; prostate gland; vas deferens; and the penial duct.

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Figure 2

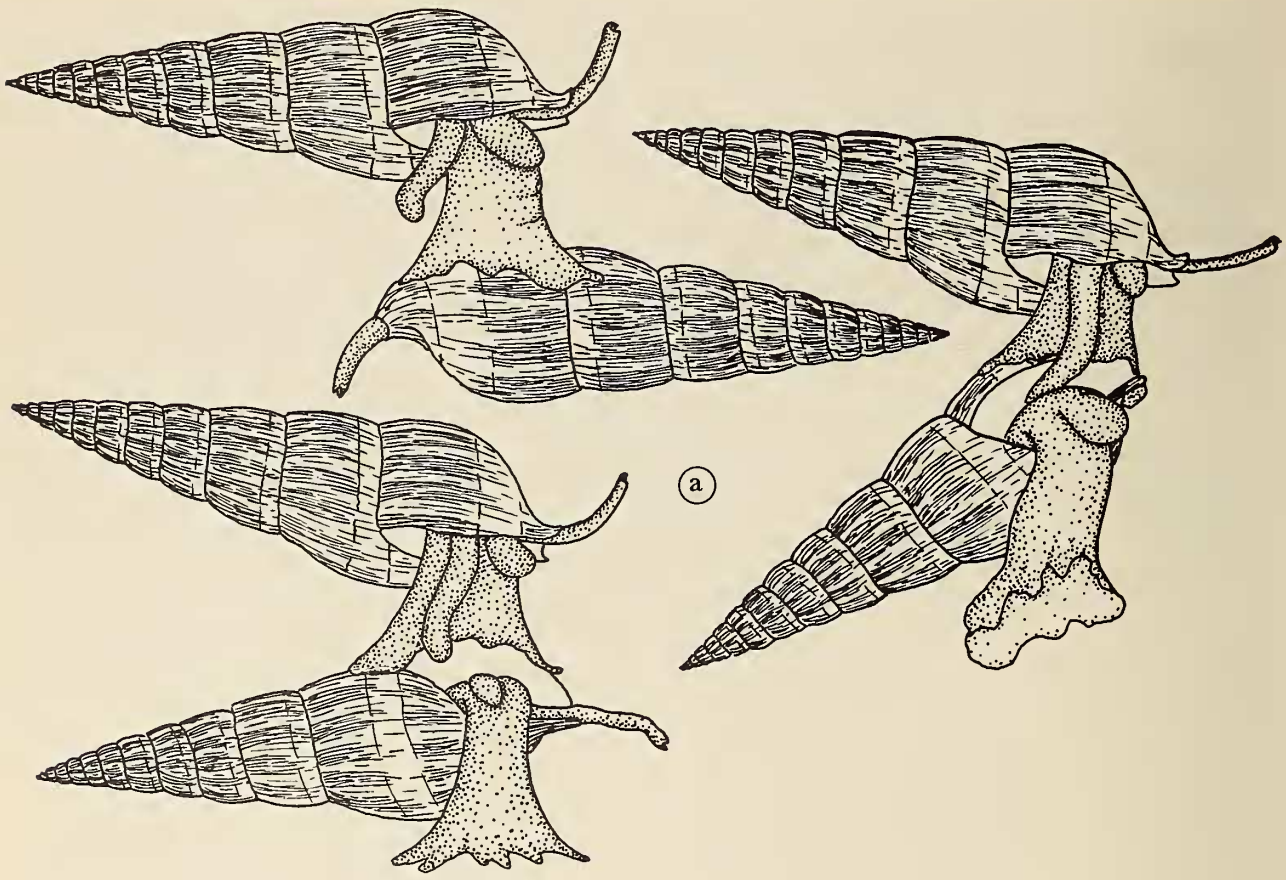
Pervicacia tristis (DESHAYES, 1859)

P – male reproductive system; Q – transverse section of prostate gland; R – transverse section of vesicula seminalis; S – transverse section of tip of penis; T – transverse section of penis; U – female reproductive system: albumen gl. = albumen gland; b.s.s. = brown staining spherules; cap gl. = capsule gland; g.p.d. = gonopericardial duct; i.g. = ingesting gland; prostate g. = prostate gland; ves. sem. = vesicula seminalis; vest. = vestibule

The testis is a large, greatly folded sac lying on the digestive gland in the top whorls of the body. From this organ runs a short duct, the testis duct, which soon widens to form the much convoluted vesicula seminalis. This runs down on the columella side of each whorl, finally narrowing to a sphincter as it enters the pallial cavity. The duct then flattens and is surrounded by glandular cells to form the prostate gland running along the dorsal side of the body. The duct then narrows and becomes surrounded with a layer of circular muscle. This is the true vas deferens and runs forward until it enters the penis just to the right of the snout. The duct passes down the penis and opens at the tip (Figure 2 P). The structure of the vesicula seminalis is the same as that of *Ocenebra* (FRETTER, 1941). The epithelium consists of columnar cells which may be ciliated, but when the organ is filled with sperm, such an observation is impossible. The nuclei of the cells are large, being either spherical or irregular in shape, and the cytoplasm is vacuolated and contains large yellow-brown staining spherules similar to those in the ingesting gland. It is thought that the vesicula seminalis also ingests sperm either to keep the duct clear or to remove old sterile sperm (Figure 2 R). The character of the epithelium alters when the vesicula seminalis enters the pallial cavity, becoming quite simple. The vesicula seminalis leads to the prostate gland situated on the right dorsal side of the body. These two regions are separated by a sphincter.

The prostate gland is a flattened region of the duct, the lateral walls being greatly thickened by the growths of glandular cells. These glandular regions on each side of the longitudinal ciliated duct differ from each other in many ways. The most obvious distinction is the colour the regions stain. The left or upper glandular region stains red, suggesting a protein or nutritive secretion, while the right dorsal region stains a light blue with Mallory Heidenhain, suggesting a mucous secretion. On the ventral side of the duct a glandular region of large columnar cells is present. The function of these cells is unknown. The lumen is ciliated on its ventral side. The vas deferens is a small heavily ciliated tube surrounded by a thick coat of circular muscle. This duct runs into the penis and travels forward on one side of the penis until it reaches the penial opening (Figure 2 Q).

The penis is a long muscular organ half the length of the animal's long axis (Figure 1). It lies folded within the mantle cavity, when not in use, and has an opening at its terminal end through which sperm can be ejected during copulation. The glandular epithelium and musculature of the penis (Figure 2 T) is extremely complex. There is an outer covering of secreting cells probably to ease passage at copulation. Inside this is a layer of ob-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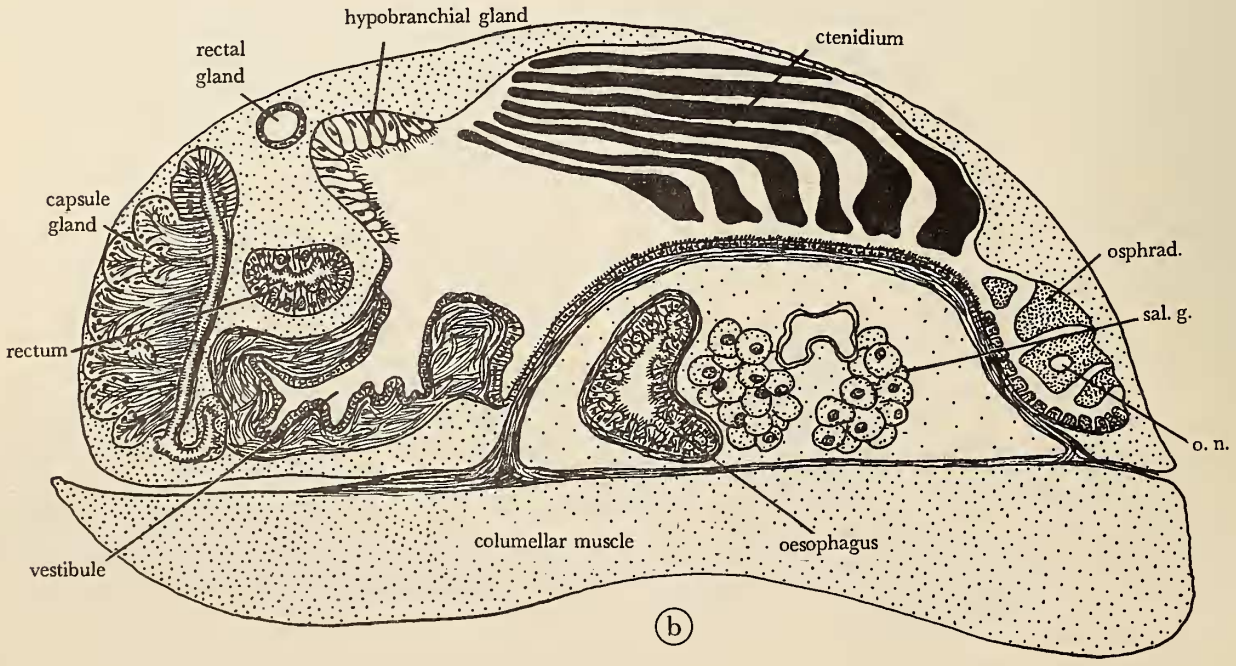
hypobranchial gland
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lique muscle surrounding a very conspicuous layer of transverse and longitudinal fibres. The centre of the penis is loosely packed with connective tissue penetrated by blood spaces. One side of the penis carries the penial seminal duct, on the other there is an open space which may be a blood channel. The penial nerve, a derivation of the pedal nerve, is situated off-centre. Proximally the seminal duct opens into a wide ciliated groove which becomes W-shaped (Figure 2 S). Both grooves and the central ridge are highly ciliated. This groove is probably a vestige of a primitive open groove along the penis. The blocks of transverse and longitudinal muscle in the penis suggest that peristalsis effects the ejection of sperm.

COMPARISON

A number of terebrids collected by Professor J. E. Morton during the Royal Society Expedition to the Solomon Islands, 1966 were kindly given to the author and a study of their gross anatomy was undertaken. The results of this are listed below:

Terebra babylonia. This animal possesses eyes on very short stalks and its reproductive system, in both sexes, is similar to that of *Pervicacia tristis*. The foregut, however, is quite different. A muscular cylinder extends back into the anterior cavity opening at its inner end through a slit bordered by a pair of muscular lips. This slit is no doubt "la fente dorsale" of Bouvier (1887) and Risbec (1953). The muscular cylinder has been called by Risbec (*op. cit.*) "la gaine de la trompe" – the proboscis sheath – in his discussion on *Terebra muscaria* Lamarck, 1822, and by Bouvier, "la gaine proboscidienne." This structure, however, is quite different from the proboscis sheath of the lower stenoglossans and a new term should be employed. Marcus & Marcus (1960) have studied the terebrid *Hastula cinerea* and use the term "anterior tube." This term, I feel, is unsatisfactory and suggest instead "pseudoproboscis." Behind the pseudoproboscis, and quite separate from it, is the true or inner mouth, the anterior opening of the alimentary canal. The proboscis is long and at its inner end passes through a thin wall separating the anterior cavity from the true body cavity. Inside the body cavity proper, a small radular sac opens into the proboscis. Also opening at this point are the salivary gland ducts and the poison gland. The long thin poison gland folds around the oesophagus and the posterior end of the proboscis, leading to the large muscular bulb often mistakenly identified as the poison gland. The oesophagus, on leaving the proboscis, folds forward under the anterior cavity, before folding back to lead posteriorly to the stomach. The radular teeth are harpoon-shaped, the chitin being formed into a rolled, hollow tube (Figure 4 Q, T).

Terebra maculata and *Terebra affinis*. These animals were also collected at the Solomon Islands and as with the above species, possess eyes on small stalks and have a reproductive system similar to that of *Pervicacia tristis*. However, the foregut again differs considerably in structure. In both these species the pseudoproboscis is extremely long (in *T. maculata* it lies folded in the anterior cavity), while the true proboscis is a small remnant devoid of radula. There is no poison gland and the salivary glands are much reduced. The oesophagus leads from the proboscis, folding under the pseudoproboscis before dropping through the ventral wall of the anterior cavity into the true body cavity. *Terebra dimidiata* was also found to have a very similar structure (Figure 4 R).

For the purposes of discussion short accounts of other terebrids already studied are listed below.

Hastula cinerea. The reproductive system is similar to that of *Pervicacia tristis* except for the possession of a small bursa copulatrix near the capsule gland. The foregut is similar to that of *T. babylonia*, the eversible pseudoproboscis, however, being shorter in relation to the proboscis (Marcus & Marcus, 1960).

Terebra muscaria. There is neither radula nor poison gland (Risbec, 1953).

Terebra cancellata. This species has both poison gland and harpoon-shaped radular teeth (Risbec, 1953).

DISCUSSION

The foregut of the Terebridae is fundamentally different from that of the Conidae and some of the Turridae, in which the alimentary canal opens externally, there being no anterior cavity. In *Cenodagreutes aethus* E. H. Smith, 1967, and *C. coccyginus* E. H. Smith, 1967, two turrids recently described from England (E. H. Smith, 1967) there is neither radular nor poison gland. In these animals the oesophagus is continuous with the large proboscis forming the rhynchodaeum, and opens directly to the outside. In *Mangelia brachystoma* (Philippi, 1844) a turrid studied by Robinson (1960) the proboscis, as in the terebrids, opens into an anterior cavity, which in turn

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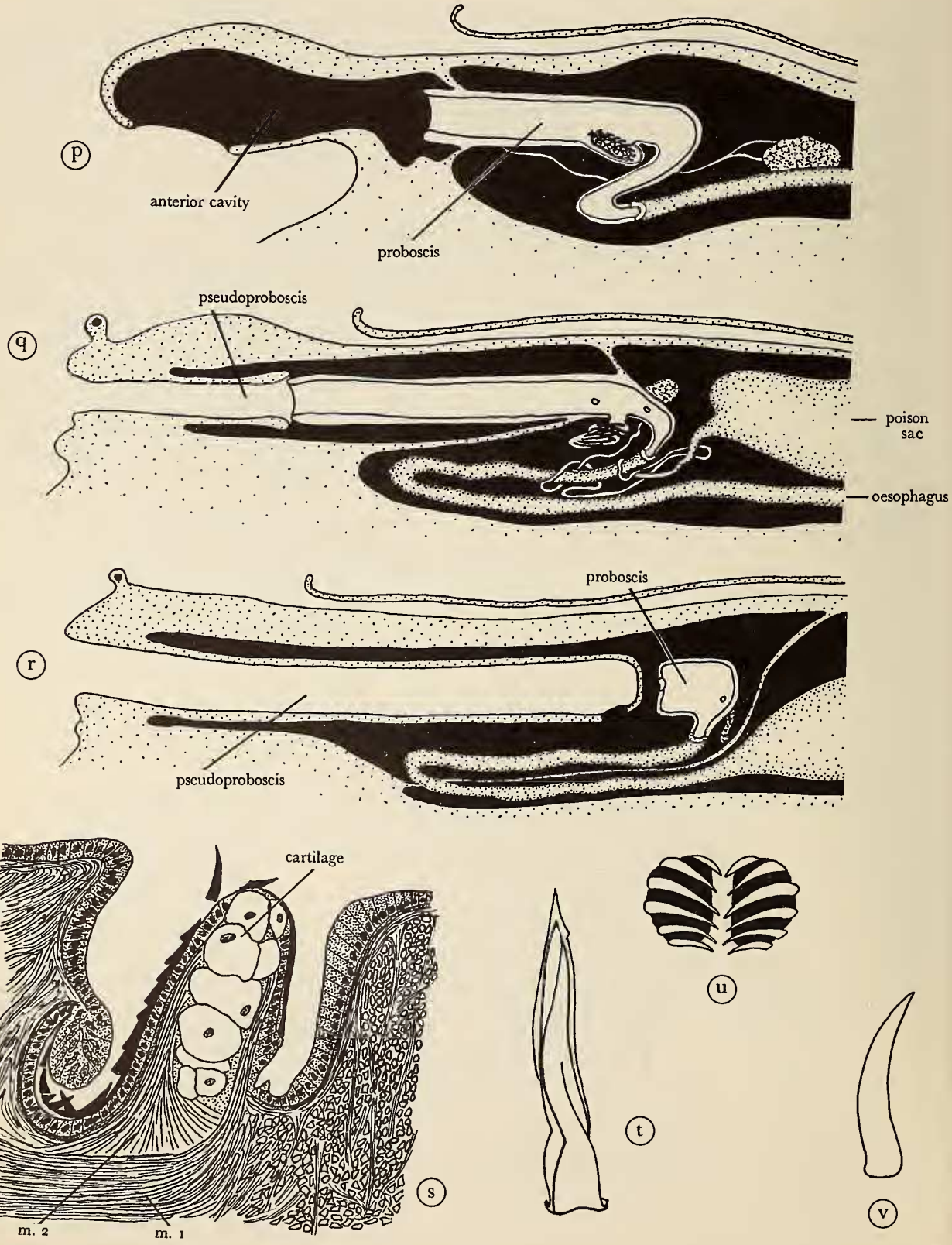
Figure 3

Pervicacia tristis (Deshayes, 1859)

A – copulation; B – transverse section through mantle cavity: hyp. gl. = hypobranchial gland; osphrad. = osphradium; o.n. = osphradial nerve; oes. = oesophagus; sal. g. = salivary gland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anterior cavity
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opens to the exterior. *Mangelia* differs from the terebrids in not having a pseudoproboscis. The anatomy of the Conidae is not well-known. The reproductive system of *Conus mediterraneus* Bruguière, 1792 has been studied (Martoja-Pierson, 1958) while Kohn's studies on feeding and the foregut of this family suggest that the foregut of the cones has more in common with the Turridae than with the Terebridae.

It is considered that the Recent families of the Toxoglossa: Terebridae, Conidae, and Turridae, are a closely related group of advanced gastropods (Powell, 1966). However, there is little known of their anatomy. Powell, whose comprehensive reclassification of the Turridae, on shell and radular characters, forms a massive contribution to our knowledge, and Kohn studying in detail the feeding and ecology of the Conidae are almost the only contemporary students of the Toxoglossa. Shorter papers of varyinf usefulness, have dealt with aspects of the anatomy and functional morphology of a few members of the group. From what is known of the toxoglossan reproductive system, *Pervicacia tristis* differs only slightly from the general pattern. In terebrids, the pallial vas deferens leads into a swollen prostate gland and from this to the tip of a long penis. As Marcus (1960) has shown in *Hastula cinerea,* in *Pervicacia tristis, Terebra affinis* and *T. maculata,* this duct is closed (personal observations). Risbec (1953) states that in *Terebra muscaria* there is an open duct. In two turrids examined, *Mangelia brachystoma* by Robinson (1960) and *Phenatoma zealandica* (E. A. Smith, 1877) by Ponder (personal communication) there is no swollen prostate region. Although no bursa copulatrix exists in *P. tristis,* a small sac near the capsule gland in the turrids *Hastula cinerea* and *Cenadogreutes* spp. (E. H. Smith, 1967), and a large sac at the genital opening of *Conus mediterraneus* studied by Martoja-Pierson, 1958, suggest that this organ is present in varying degrees throughout the Toxoglossa.

This study has shown that the foregut of the members of the Terebridae has developed a peculiar structure, the pseudoproboscis. In *Hastula cinerea* this structure is small and is everted during feeding (E. & E. Marcus, 1960).

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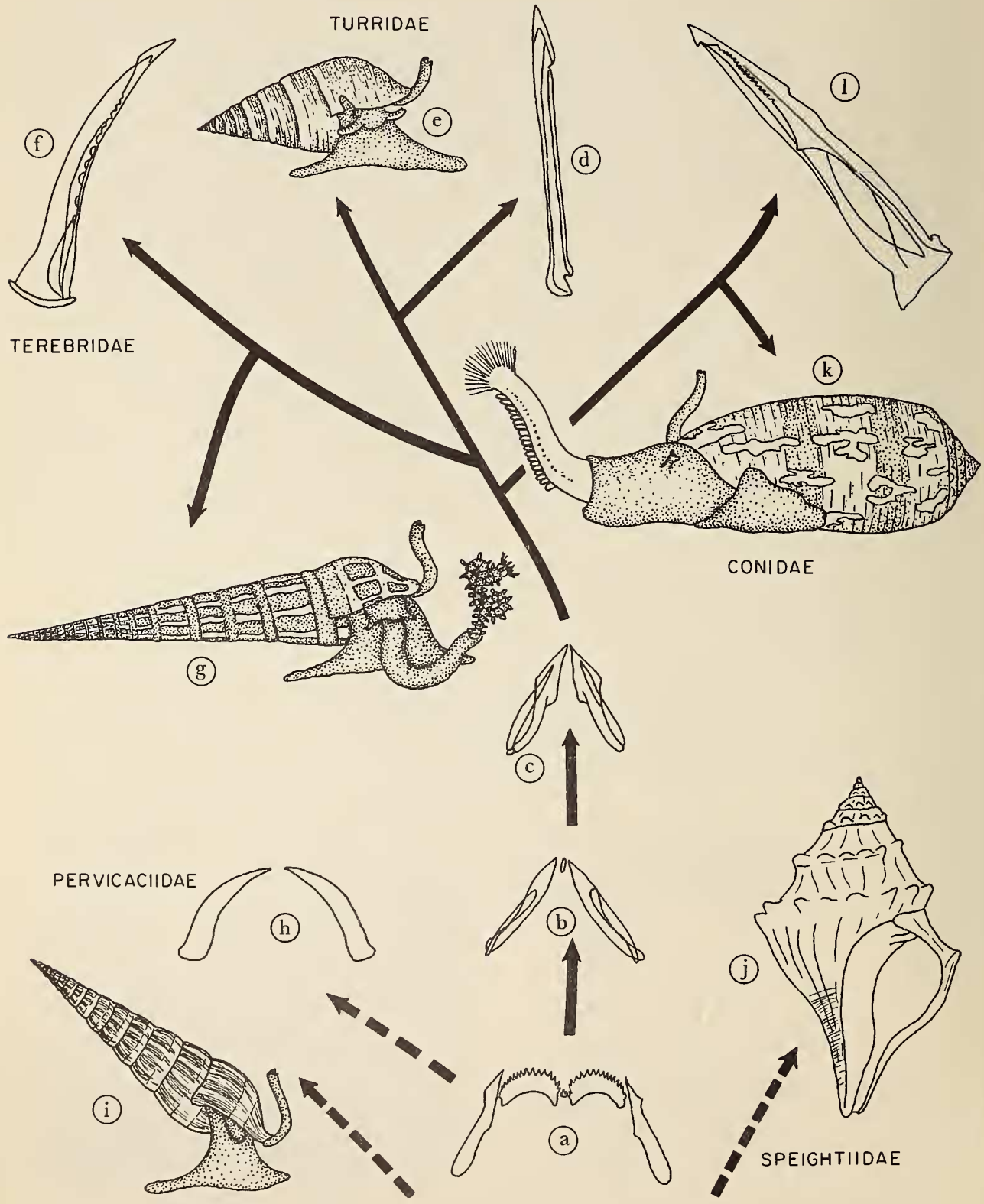
Figure 4

Pervicacia tristis (Deshayes, 1859)

P – sagittal section through head region U – dorsal view of odontophore; V – tooth; S – section through odontophore.
Terebra babylonia: Q – sagittal section through head region; T – tooth.
Terebra affinis: R – sagittal section through head region.

When this tube is not everted (that is, lying in the anterior cavity), the opening at its inner end is near the opening of the alimentary canal. In *Terebra maculata* this opening of the pseudoproboscis is a ventral slit bordered by a pair of muscular lips, and is similar in structure to the opening of the anterior cavity of *Pervicacia tristis.* In *T. babylonia* the opening is in a central position while in *H. cinerea* it is dorsally placed. The size of the pseudoproboscis differs from species to species; in *Hastula* the tube is short, the true proboscis long and folded and there are both poison gland and harpoon-shaped radular teeth. *Terebra babylonia* is similar although the pseudoproboscis is relatively longer. In the three species studied having neither radular nor poison gland the pseudoproboscis is very long and in *T. maculata* the length is so great that the tube is folded about itself when lying in the anterior cavity. In contrast to *T. babylonia* the true proboscis in these forms is extremely small, being merely a short muscular vestibule at the end of the oesophagus. There is little doubt that in these cases the prey is caught, not by the "typical" toxoglossan method of harpooning the prey with a poison tooth, but by the long pseudoproboscis being everted and sucking in the prey (Figure 5 G). One difficulty in understanding this rather unique method of food collecting is the question of how food is transported from the pseudoproboscis to the opening of the true proboscis with which there is no direct connection. This problem cannot be solved with preserved material and must wait a study of living animals.

The one character which distinguishes the Toxoglossa from all other gastropods is the possession, by some members of each family, of a poison gland and harpoon-shaped radula teeth. As Powell (1966) has suggested, it is most probable that the Conidae and the Terebridae are specialised off-shoots from turrid stock. The Turridae possess a wide range of radular teeth with formulae ranging from the prototypic 1·1·1·1·1 of *Drillia* and *Clavus,* where the laterals are wide and serrate, to the advanced 1·0·0 ·0·1 harpoon-shape of *Phenatoma* (Figures 5 A - D). In all cases studied by Ponder, a poison gland was present, even in the cases where a prototypic radula was present. Only in the most advanced forms was a cartilaginous odontophore absent (W. F. Ponder, personal communication). The genus *Cenodagreutes* is unique in the turrids, the radula, poison gland and salivary glands being completely absent (E. H. Smith, 1967). The generic name meaning "the toothless hunter" is very apt. It is difficult to agree with Powell's proposed subfamily classification of the Turridae. In three of the subfamilies, Clavinae, Mangeliinae, and Clavatulinae, there are species possessing the advanced harpoon-shaped radular teeth and species possessing more primitive radular forms. Considering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SPEIGHTIIDAE

that subfamilies should represent common lines of descent, if we are to agree to POWELL's groupings, then we must also agree that harpoon-shaped radular teeth have arisen independently on three different occasions. Because of the close relationships of this group this does not seem reasonable.

In the Conidae all species that have been studied have a specialised foregut with a poison gland and an advanced radular tooth (Figure 5 L). With the exception of *Pervicacia tristis*, the terebrids fall into two categories. One group has a foregut similar to that of the cones, while the other has neither poison gland nor radula. It is suggested that the latter group has lost these organs. It is therefore possible to suppose that, with the exception of *Pervicacia*, both the Conidae and the Terebridae arose independently from turrids that had developed harpoon-shaped radular teeth.

The genus *Pervicacia* is unique within the Toxoglossa, having no poison gland and having a primitive type of radula. Although the shell is terebrid in shape, no valid phylogenetic argument could continue to place it in the Terebridae. A new family within the Toxoglossa is therefore proposed.

Pervicaciidae new family.

Toxoglossan gastropods bearing a terebrid-like shell, axially ribbed. The shell is auger-shaped, less highly calcified than in the Terebridae. Radula primitive, 1·0·0·0·1, odontophoral cartilage blocks present. Poison gland absent. **Type genus:** *Pervicacia* IREDALE, 1924.

It is doubtful if the family Pervicaciidae is even toxoglossan, but the similarity of the reproductive system, and because the radula is similar to that of some primitive turrids, it was decided to leave it within the superfamily Toxoglossa.

It is suggested that sometime before the Cretaceous a gastropod developed a single poison gland and a radula perhaps similar to that of *Drillia umbilicata* (GRAY, 1838), and through gradual loss of the central and marginal teeth the turrids developed the highly specialised radular form of *Phenatoma zealandica* (E. A. SMITH, 1877). Early in this development a form such as *Pervicacia* could have split off leading, with loss of the poison gland, to the genus *Pervicacia*. Both the Conidae and the Terebridae split from the turrid line after the development of the harpoon-shaped radular teeth. Some terebrids have specialised further than the cones, members having lost both the poison gland and the radula. One fossil family placed with the Toxoglossa, the Speightiidae, disappears from the fossil record at the end of the Eocene (POWELL, 1966) and their inclusion within the superfamily is purely conjectural. As mentioned earlier, POWELL's internal classification of the Turridae must remain open to doubt until more than the shell and radula is known in this family (Figure 5).

The similarity of shell between the Terebridae and the Pervicaciidae is not unparalleled in the Toxoglossa, the Conidae having a similar shell-shape to that of *Conorbis dormitor* SOLANDER, 1766, a supposed turrid. Within the cones certain plasticity is seen in the shell, the fast moving piscivorous forms, such as *Conus geographus* LINNAEUS, 1758, have lightly calcified, wide apertured shells while the slower vermivores have heavy shells with slit-like apertures. It is reasonable to assume that, through living in similar habitats, the terebrids and the pervicacids have developed similarly shaped stream-lined shells.

(<— on facing page)

Figure 5

Suggested phylogenetic relationships within the Toxoglossa
Turridae:
A – *Drillia umbilicata* (GRAY, 1838), radula
B – *Rhodopetoma rhodope* (DALL, 1919), radula
C – *Haedropleura septangularis* (MONTAGU, 1803), radula
D – *Phenatoma zealandica* (SMITH, 1877), radula
E – *Phenatoma zealandica* (SMITH, 1877), animal
Terebridae:
F – *Hastula cinerea* (BORN, 1780), radula
G – *Terebra dimidiata* (LINNAEUS, 1758), ingesting worm
Pervicaciidae:
H – *Pervicacia tristis* (DESHAYES, 1859), radula
I – *Pervicacia tristis* (DESHAYES, 1859), animal
Speightiidae:
J – *Speightia spinosa* (SUTER, 1917)
Conidae:
K – *Conus striatus* LINNAEUS, 1758, ingesting fish
L – *Conus arenatus* BRUGUIÈRE, 1792, radula
(A, B, C, after POWELL, 1964; F, after MARCUS, 1960; K, partly from photo, KOHN, 1956; L, after THIELE, 1931)

SUMMARY

A study of *Pervicacia tristis* (DESHAYES, 1859) with special reference to the gut and reproductive system. The possession of a cartilaginous odontophore and primitive radula is reported. The foregut region of a number of tropical terebrids: *Terebra maculata* LINNAEUS, 1758, *T. dimidiata* LINNAEUS, 1758, *T. babylonia* LAMARCK, 1822, and *T. affinis* GRAY, 1834 is described. These species are compared with some other toxoglossans whose ana-

tomy has been studied previously. The genus *Pervicacia* is removed from the Terebridae and a new family is proposed to contain it.

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